

What is claimed is:

1 1. A method for losslessly embedding a message into a digital object comprised
2 of samples, said method comprising the steps of:

3 extracting from said object a first subset that is losslessly compressible;
4 said first subset having the property that it can be randomized while preserving
5 the perceptual quality of said object;

6 compressing said first subset into a compressed bitstream;
7 concatenating said compressed bitstream with said message to form a second
8 subset;

9 inserting said second subset into said object in place of said first subset to form a
10 transformed object, whereby said message is effectively transmitted and extracted by
11 transmitting said transformed object and extracting said second subset therefrom; and

12 restoring said object by decompressing said compressed bitstream, restoring said
13 first subset, and reinserting said first subset into said object.

14 2. The method of claim 1, wherein said digital object is an uncompressed image.

15 3. The method of claim 1, wherein said digital object is an image in a lossy image
16 format.

17 4. The method of claim 1, wherein said digital object is an audio file or a video
18 file.

19 5. The method of claim 1, wherein said first subset comprises all bits from a fixed
20 bitplane.

1 6. The method of claim 1, wherein said first subset is generated by adding
2 invertible noise (flipping) and applying special discrimination (prediction) functions to
3 small groups of pixels in said digital object.

1 7. The method of claim 1, wherein said message is a digital watermark.

1 8. The method of claim 1, wherein said message is an authentication code.

1 9. A method for losslessly embedding a message into a digital object comprised
2 of samples, each of said samples having an original value, said method comprising the
3 steps of:

4 defining a first set $S(x)$, whose values are equal to x , as a first subset of samples
5 from said object;

6 defining a second set $S(y)$, whose values are equal to y , as a second subset of
7 samples from said object;

8 assigning a first value to x and a second value to y , wherein said values x and y
9 are close together and said first and second subsets $S(x)$ and $S(y)$ differ substantially in
10 size;

11 scanning said object in a defined pattern, whereby members of $S(x)$ and $S(y)$ are
12 losslessly compressed to form a bitstream;

13 concatenating said bitstream with said message and embedding a concatenation
14 into a union of said first and second subsets $S(x)$ and $S(y)$ by scanning said object in said
15 defined pattern and choosing said first value to embed an x and said second value to
16 embed a y , whereby said message is effectively transmitted and extracted by transmitting
17 said concatenation and extracting said second message therefrom; and

18 restoring said object by decompressing said concatenation, scanning said object in
19 said defined pattern, and restoring said original values in said object.

1 10. The method of claim 9, wherein said digital object is a palette image, an
2 uncompressed image, an audio file, or a video file.

1 11. The method of claim 9, wherein said digital object is a watermark.

1 12. The method of claim 9, wherein said digital object is an authentication code.

1 13. Apparatus for losslessly embedding a message into a digital object comprised
2 of samples, said apparatus comprising:
3 means for extracting from said object a first subset that is losslessly compressible;
4 said first subset having the property that it can be randomized while preserving
5 the perceptual quality of said object;
6 means for compressing said first subset into a compressed bitstream;
7 means for concatenating said compressed bitstream with said message to form a
8 second subset;
9 means for inserting said second subset into said object in place of said first subset
10 to form a transformed object, whereby said message is effectively transmitted and
11 extracted by transmitting said transformed object and extracting said second subset
12 therefrom; and
13 means for restoring said object by (1) decompressing said compressed bitstream,
14 (2) restoring said first subset, and (3) reinserting said first subset into said object.

1 14. Apparatus as in claim 13, wherein said digital object is an uncompressed
2 image.

1 15. Apparatus as in claim 13, wherein said digital object is an image in a lossy
2 image format.

1 16. Apparatus as in claim 13, wherein said digital object is an audio file or a video
2 file.

1 17. Apparatus as in claim 13, wherein said first subset comprises all bits from a
2 fixed bitplane.

1 18. Apparatus as in claim 13, wherein said first subset is generated by adding
2 invertible noise (flipping) and applying special discrimination (prediction) functions to
3 small groups of pixels in said digital object.

1 19. Apparatus as in claim 13, wherein said message is a digital watermark.

1 20. Apparatus as in claim 13, wherein said message is an authentication code.

1 21. Apparatus for losslessly embedding a message into a digital object comprised
2 of samples, each of said samples having an original value, said apparatus comprising:

3 means for defining a first set $S(x)$, whose values are equal to x , as a first subset of
4 samples from said object;

5 means for defining a second set $S(y)$, whose values are equal to y , as a second
6 subset of samples from said object;

7 means for assigning a first value to x and a second value to y , wherein said values
8 x and y are close together and said first and second subsets $S(x)$ and $S(y)$ differ
9 substantially in size;

10 means for scanning said object in a defined pattern, whereby members of $S(x)$ and
11 $S(y)$ are losslessly compressed to form a bitstream; Apparatus for losslessly embedding a
12 message into a digital object comprised of samples, each of said samples having an
13 original value, said apparatus comprising:

14 means for defining a first set $S(x)$, whose values are equal to x , as a first subset of
15 samples from said object;

16 means for defining a second set $S(y)$, whose values are equal to y , as a second
17 subset of samples from said object;
18 means for assigning a first value to x and a second value to y , wherein said values
19 x and y are close together and said first and second subsets $S(x)$ and $S(y)$ differ
20 substantially in size;
21 means for scanning said object in a defined pattern, whereby members of $S(x)$ and
22 $S(y)$ are losslessly compressed to form a bitstream;
23 means for concatenating said bitstream with said message and embedding a
24 concatenation into a union of said first and second subsets $S(x)$ and $S(y)$ by scanning said
25 object in said defined pattern and choosing said first value to embed an x and said second
26 value to embed a y , whereby said message is effectively transmitted and extracted by
27 transmitting said concatenation and extracting said second message therefrom; and
28 means for restoring said object by (1) decompressing said concatenation, (2)
29 scanning said object in said defined pattern, and (3) restoring said original values in said
30 object.
31 means for concatenating said bitstream with said message and embedding a
32 concatenation into a union of said first and second subsets $S(x)$ and $S(y)$ by scanning said
33 object in said defined pattern and choosing said first value to embed an x and said second
34 value to embed a y , whereby said message is effectively transmitted and extracted by
35 transmitting said concatenation and extracting said second message therefrom; and
36 means for restoring said object by (1) decompressing said concatenation, (2)
37 scanning said object in said defined pattern, and (3) restoring said original values in said
38 object.

1 22. Apparatus as in claim 21, wherein said digital object is a palette image, an
2 uncompressed image, an audio file, or a video file.

1 23. Apparatus as in claim 21, wherein said digital object is a watermark.

1 24. Apparatus as in claim 21, wherein said digital object is an authentication code.

1 25. A computer-readable storage medium embodying program instructions for a
2 method for losslessly embedding a message into a digital object comprised of samples,
3 said method comprising the steps of:

4 extracting from said object a first subset that is losslessly compressible;

5 said first subset having the property that it can be randomized while preserving
6 the perceptual quality of said object;

7 compressing said first subset into a compressed bitstream;

8 concatenating said compressed bitstream with said message to form a second
9 subset;

10 inserting said second subset into said object in place of said first subset to form a
11 transformed object, whereby said message is effectively transmitted and extracted by
12 transmitting said transformed object and extracting said second subset therefrom; and

13 restoring said object by decompressing said compressed bitstream, restoring said
14 first subset, and reinserting said first subset into said object.

1 26. A computer-readable storage medium embodying program instructions for a
2 method for losslessly embedding a message into a digital object comprised of samples,
3 each of said samples having an original value, said method comprising the steps of:
4 defining a first set $S(x)$, whose values are equal to x , as a first subset of samples
5 from said object;
6 defining a second set $S(y)$, whose values are equal to y , as a second subset of
7 samples from said object;
8 assigning a first value to x and a second value to y , wherein said values x and y
9 are close together and said first and second subsets $S(x)$ and $S(y)$ differ substantially in
10 size;
11 scanning said object in a defined pattern, whereby members of $S(x)$ and $S(y)$ are
12 losslessly compressed to form a bitstream;
13 concatenating said bitstream with said message and embedding a concatenation
14 into a union of said first and second subsets $S(x)$ and $S(y)$ by scanning said object in said
15 defined pattern and choosing said first value to embed an x and said second value to
16 embed a y , whereby said message is effectively transmitted and extracted by transmitting
17 said concatenation and extracting said second message therefrom; and
18 restoring said object by decompressing said concatenation, scanning said object in
19 said defined pattern, and restoring said original values in said object.